

Running Head: DETERIMING STAFFING REQUIREMENTS AT THE DSOC

Graduate Management Project

Optimizing the Department of Defense Spatial Orientation
Center Vestibular Rehabilitation Staffing Using Simulation
Software

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Abstract

The Naval Medical Center, San Diego (NMCSD) Commander created the Defense Spatial Orientation Center (DSOC) supporting advances in treating vestibular dysfunction. Now the DSOC needs to expand so that it may better support the military operational forces. Opening a clinic on Marine Corps Air Station (MCAS), Miramar facilitates increased exposure to the active duty personnel who will benefit from vestibular rehabilitation. The DSOC directors must therefore determine the staffing needed to run the clinic at both NMCSD and MCAS. This research hypothesizes that a single physical therapist can not successfully complete the necessary annual patient visits to support the beneficiary population. MedModel® simulation software was selected to analyze this hypothesis; it allows for relatively quick results without disturbing patient care. The results predict the vestibular rehabilitation clinic staff must expand, at a minimum, by one physical therapist and two technicians. This staffing mix can then support approximately 4,600 annual visits. Also, the addition of technicians decreases the patient visit cost and therefore the government's cost of providing treatment. Thus, having a clinic at MCAS not only increases the number of active duty personnel who get this critical treatment but the change in staff composition ultimately helps the government avoid training and equipment replacement costs.

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INTRODUCTION

Each year in this country, an astonishing number of people experience either hearing or vestibular (balance) problems. The National Institutes of Health estimates that nearly two million adult Americans are chronically impaired due to dizziness or have difficulty with balance (National Institutes on Deafness, 1998). They similarly report that "hearing loss afflicts approximately 28 million people", with nearly one-fourth of these impairments being caused in part by "...damage from exposure to loud sounds" (National Institutes of Health, 1998).

Hearing loss is a significant problem within the Armed Forces. In a representative sample of surface and submarine personnel, 29% experienced a significant reduction in hearing from their baseline hearing examination (Hoffer, 1998, p. 12). These problems range from temporary reductions of hearing ability, to complete and permanent loss of hearing.

For the military, hearing and balance problems result in approximately \$1.5 million dollars worth of avoidable losses each year (Hoffer, 1998, p. 1). These costs are avoidable in that hearing and vestibular problems are increasingly being addressed both through ongoing prevention initiatives and relatively new therapeutic modalities designed to restore inner ear hearing function (Hoffer, 1998, p. 1).

Military commanders have shown interest and support in hearing prevention programs, and are now demonstrating concern with how new technologies may impact the motion adaptation of their personnel.

Conditions Which Prompted the Study

Treating Spatial Orientation Dysfunction

Although dedicated programs addressing the prevention of hearing disorders have been in effect for several years, vestibular problems have not been similarly addressed. Traditionally, vestibular dysfunction has not been as well understood by line commanders; as a result, the military shows limited support and advancement in this arena. This lack of action is unfortunate, as approximately 11% of active duty personnel are "impaired in their ability to perform their mission due to a treatable balance or hearing disorder" (Hoffer, 1998, p. 2). Various forms of vestibular dysfunction result in a significant cost to the military.

In today's military, personnel are routinely expected to use expensive high-technology equipment under extreme conditions. For example, they must withstand the forces of gravity while flying multi-million dollar aircraft. Personnel with balance-related disorders often attempt to perform these responsibilities with tragic results. In addition, affected people are frequently pulled from their responsibilities, forcing the Department of Defense (DoD) to choose between

reduced force capabilities or training replacement personnel. Dr. Hoffer shows in his proposal that during fiscal years 1991 to 1995 Navy mishaps due to vestibular disorders cost DoD approximately \$753.8 million (1998, p. 10).

Efforts to treat vestibular dysfunction have in the past been accomplished through a multi-disciplinary team, composed of members from both the otolaryngology and audiology departments. The audiologist focused on diagnosing hearing loss and fitting the member with hearing aids, while the neurotologist addressed the medical and surgical issues associated with the vestibular and hearing systems, focusing on treatment options and prevention of further impairment. Recently, physical therapists were added to the team, further increasing the impact of the hospital's organizational structure on patient care. Such a multi-departmental system design exposes the patient to increased bureaucracy, redundancy and missed communication, possibly leading to poor treatment outcomes.

The Defense Spatial Orientation Center Proposal

Several of the physicians and ancillary care providers at the Naval Medical Center, San Diego (NMCSO) are currently working to improve the diagnosis and treatment of vestibular dysfunction in active duty members. Their efforts have helped to maximize the training dollars expended on the active duty population and to minimize the loss of military assets. These

efforts include developing, through basic and clinical research, new surgical, therapeutic and pharmacological treatment modalities, to both maintain and rehabilitate the military force.

In an effort to streamline the process and facilitate research, two neurotologists, Doctors Hoffer and Kopke identified key Medical Center staff members for inclusion on the spatial orientation team. While not formally funded the Defense Spatial Orientation Center (DSOC) has been created within the structure of NMCSO in the Department of Otolaryngology. This change, which occurred in 1998, demonstrates the Commander's commitment to the advances in the diagnosis and treatment of spatial orientation problems within the military. Doctors Hoffer and Kopke were designated as co-directors of the Center.

Table 1: Vestibular Staff

Staff Category	Number
Neurotologist	2
Neuroaudiologist	1
Physical Therapist	1
ENT Technicians	2
Research Associates	2
Administrative Assistant	1

Currently, the DSOC utilizes spaces within two separate buildings on the Medical Center campus. The staff consists of five different categories of personnel, (Table 1).

DSOC Issues

In an era of funding constraints and managed care, the creation of a new department in a major medical center presents a myriad of issues for the leadership to address. Therefore, in moving forward with the Center, it is essential to undertake management research, facilitating meaningful decisions on the design of a new service. Such research assists the leaders in making decisions regarding the staffing, the location, the necessary equipment and the organizational structure of the Center.

Hearing and vestibular dysfunction have significant impact on military operations. Having the services offered by DSOC on the hospital campus is not consistent with the military goal of serving active duty members in close proximity to their work site. This generates perhaps the largest barrier to meeting the directors' goal of serving the active duty military population. To improve access to military personnel, the directors have identified spaces at the Marine Corps Air Station, Miramar (MCAS) in which to provide a vestibular rehabilitation program for active duty aviators and others in the Southern California military population.

Although, the long-term objectives of the DSOC include care for both hearing loss and vestibular patients, the immediate research focuses specifically on vestibular rehabilitation. Doctors Hoffer and Kopke wish to maximize

their limited resources to establish an effective program in support of the operational forces, while continuing to serve the population requiring care at the Medical Center. The lack of adequate staffing available for this endeavor is a significant hurdle; this research project will focus on identifying the staffing requirements to support this new clinic.

Statement of the Problem or Question

The directors of DSOC must determine how to best use their limited personnel resources to staff the Center in support of the operational forces. They must consider the current resources, the impact of a new provider mix, the redesign of the clinic, and the impact of moving the program to a 5,000 square foot building identified at MCAS. Moving to MCAS makes the Center readily available to the active duty personnel immediately in need of the diagnostic treatment modalities the DSOC offers, but raises the question of how best to continue serving the patients needing vestibular rehabilitation at NMCS. Additionally, some of the staff involved with this initiative will continue to have other responsibilities that require them to spend at least part of their time at the Medical Center.

Having made their initial staffing decisions for the Center, the directors must determine how to maximize the number of patients being seen. However, they do not know the

workload capacity of the existing staff, and furthermore, they do not know how changes in staffing levels will impact patient care. Additionally, they suspect that the current layout of the Center adversely effects efficiency and patient visit capacity. To make this determination, the directors must fully understand how staffing, clinic layout, and patient flow impact the number of patients the Center can treat at a given time. At the same time, consideration must be given to the upcoming move to MCAS and its impact on capacity and quality of patient care.

Literature Review

The directors of the DSOC are not alone in recognizing the importance of creating a center dedicated to spatial orientation dysfunction. Spindel believes that "without access to adequate diagnostic facilities, management of vestibular and balance disorders can be a frustrating process for both clinicians and patients" (1997, p. 756). Additionally, research over the past several years reports on the successful use of specialized vestibular rehabilitation therapy treatment primarily performed by physical therapists (Telian & Shepard, 1996, p. 359; Enloe & Shields, 1997, p. 891). Clearly the directors are on the cutting edge of vestibular rehabilitation.

Being a one-of-a-kind clinic in military medicine, there is no available literature directly addressing staffing issues

and concerns in developing and managing a vestibular rehabilitation clinic. Similarly, there is a paucity of literature from the civilian community due to the relative newness of the specialty. However, the fundamental questions concerning staffing and space allocation are issues germane to other medical outpatient clinic settings, and accordingly, literature on these issues from different types of clinics can be used as a foundation in preparing this research project.

Watching patients suffer from a treatable dysfunction is a natural motivation for the care provider to attempt to hire more staff and increase the number of appointments. However, in a managed care environment, it is increasingly important to balance patient access to health care with the cost of providing services. During the 1980's health care administrators saw both the government and private insurance companies institute cost-containment measures (Feldstein, 1994, p. 7). This in turn, drove them to increasingly make data-driven decisions, instead of simply "throwing money at the problem" (LaCourse, 1996, p. 65). While the military medical system, in the past, was not directly impacted by the civilian health care delivery, it has always recognized the importance of making well-informed decisions about such issues. As such, the directors want to ensure that all appropriate data are gathered on the impact of this potential change before disrupting the current system.

The questions then become how best to understand the system, to understand how future changes to the clinic design will impact the overall clinic operations, and to collect the critical information necessary in making the tough decisions on the expanded operations of the clinic. One frequently used tool is modeling. Modeling is a means to represent, in a simplified manner, an empirical situation (Bonini, Hausman & Bierman, 1997, p. 5). A model enables the decision-maker to make more informed decisions quickly and effectively. Simulation is a detailed model of a real system; estimating how the system will react to a specific change (Bateman, Bowden, Gogg, Harrell & Mott, 1997, p. 2).

Simulation is nothing new to the health care industry. A review of the literature finds that using computer simulation before making significant staffing adjustments has been used as an administrative tool for several decades (Lin, Jang, Sedani, Thomas, Barker & Flynn, 1996, p. 1561; Robinson, Wing & Davis, 1968, p. 168; Saunders, Makens & Leblanc, 1989, p. 134).

Computer simulation is especially useful in that it quickly allows the manager to manipulate variables and include the use of realistic statistical distributions, without fear of poor patient outcomes. This makes computer simulation an extremely important tool in an environment of reduced or fixed

resources, and ideal for analyzing health care delivery in the military setting.

Determining the appropriate staffing for a clinical service requires knowing how a particular staff mix impacts lunch, holiday and vacation schedules, as well as absences due to illness. A simulation model allows such questions to be studied and provides management with "something more than a seat-of-the-pants" answer (Clague, Reed, Barlow, Rada, Clarke & Edwards, 1997, p. 197; Shirazi & Mejia, 1996, p. 10; Wolf, Gabriel & Omachonu, 1992, p. 64A). This makes simulation increasingly desirable, when tying it back to the importance of having data driven decisions.

To be accurate, the simulation model must include any unique organizational constraints. It must also use a well-defined objective and scope of the staffing problem at hand (Wolf, Gabriel & Omachonu, 1992, p. 64D). This is another argument for computerized simulation, which is more flexible than other modeling types, in addressing clinic specific issues.

One of the necessary steps in creating the model is to develop a mechanism to collect data on work performed. This allows for the person collecting the data to easily record observations and to translate them into data that the computer model will accept. The tool needs to include more than just patient treatment time, it must also address time spent on

other activities such as customer relations, phone calls, management, and patient preparation (Lin, Jang, Sedani, Thomas, Barker & Flynn, 1996, p. 1559).

Peterson in his modeling of an ambulatory clinic used an eight step information collection process for ensuring capture of supporting documentation for determining "service times, frequencies of events, arrival times of patients and availability of resources" (1996, p. 301). The steps included such things as document process flow, identifying resources, understanding patients and investigating constraints (Peterson, 1996, pp. 301-302). Similar data and processing steps are used in determining the staffing of the DSOC.

The simulation modeling software used in this project was MedModel®, Health Care Simulation Software version 3.5 by ProModel® Corporation. This particular software application includes the use of animation, which helps to visualize the flow of patients and providers and quickly identifies bottlenecks. A visual portrayal of the model provides "an easier and more complete understanding" of the system (Lin, Jang, Sedani, Thomas, Barker & Flynn, 1996, p. 1562).

Purpose

The purpose of this research project is to determine, based on simulation software and the known prevalence of vestibular dysfunction in the military population, the most appropriate staffing mix for the DSOC. This determination

begins using the existing staff, assigned spaces, and equipment to perform the mission of the Center. An optimal staffing mix will enable the Center to work in the most cost-effective manner and to increase patient access to the treatments offered through the DSOC. The mix of staff must be sufficient to operate a clinic both at the Medical Center and at MCAS. Furthermore, the research compares the cost of providing this care in the military medical system and the civilian community. This information can then be presented to the NMCS D Executive Steering Council, who can make an informed and empirically supported request through the chain of command for staffing changes, if necessary.

HYPOTHESIS: The current vestibular rehabilitation staffing mix will not optimally support the DSOC's stated mission.

METHODS AND PROCEDURES

Determining the appropriate staffing mix for the DSOC operating both at NMCSO and MCAS will be accomplished in five distinct phases, shown in Table 2. This chapter addresses the major issues of phases one through three. Phases four and five, the Results, Discussion, and Conclusion and Recommendations are addressed in their corresponding chapters.

Table 2: Project Phases

Phase	Description
One	Define problem and objectives
Two	Establish variables and simulation model
Three	Collect data/run simulation
Four	Analyze results
Five	Report findings and make recommendations

Phase One

Phase one of this research was dedicated to developing an understanding of the current and projected clinic workload capacity and how this may impact the expansion to the MCAS location. During this phase patient flow, workload data, and staffing costs were collected. This information was then used to develop specific project objectives.

Study of Situation

The first step in this phase was to develop a detailed understanding of how the vestibular rehabilitation clinic

operates. This information was gathered through interviewing and observing the clinic staff and Center directors.

Currently, the sources of patient referrals to vestibular rehabilitation are through the NMCSO neurotologists and consults from other military physicians. Once identified, the patient begins with an initial assessment, which is done by a DSOC neurotologist and the physical therapist. The evaluation includes both a physical examination and an assessment survey that is completed by the patient. These procedures help determine the extent of the patient's vestibular difficulties and then the subsequent course of treatment.

The neurotologist and the physical therapist select one of three courses of treatment for the patient. They may recommend that the patient receive a full treatment regimen, consisting of a cycle of eight physical therapy appointments, a partial treatment regimen, or a one-time appointment with the physical therapist. These regimens can also be modified slightly to meet the specific vestibular rehabilitation needs of the patient. The full treatment regimen includes an evaluation by the DSOC audiologist at the beginning and end of the eight-visit cycle, while the partial regimen only involves treatment time with the physical therapist. The average number of physical therapy vestibular rehabilitation visits is six. Figure 1 depicts the patient flow within the clinic.

Historically, a specific initial evaluation clinic has been held one morning a week and during this clinic time the neurotologist and physical therapist evaluate approximately seven patients. According to the DSOC staff, the current waiting time for the initial evaluation clinic is four to five weeks.

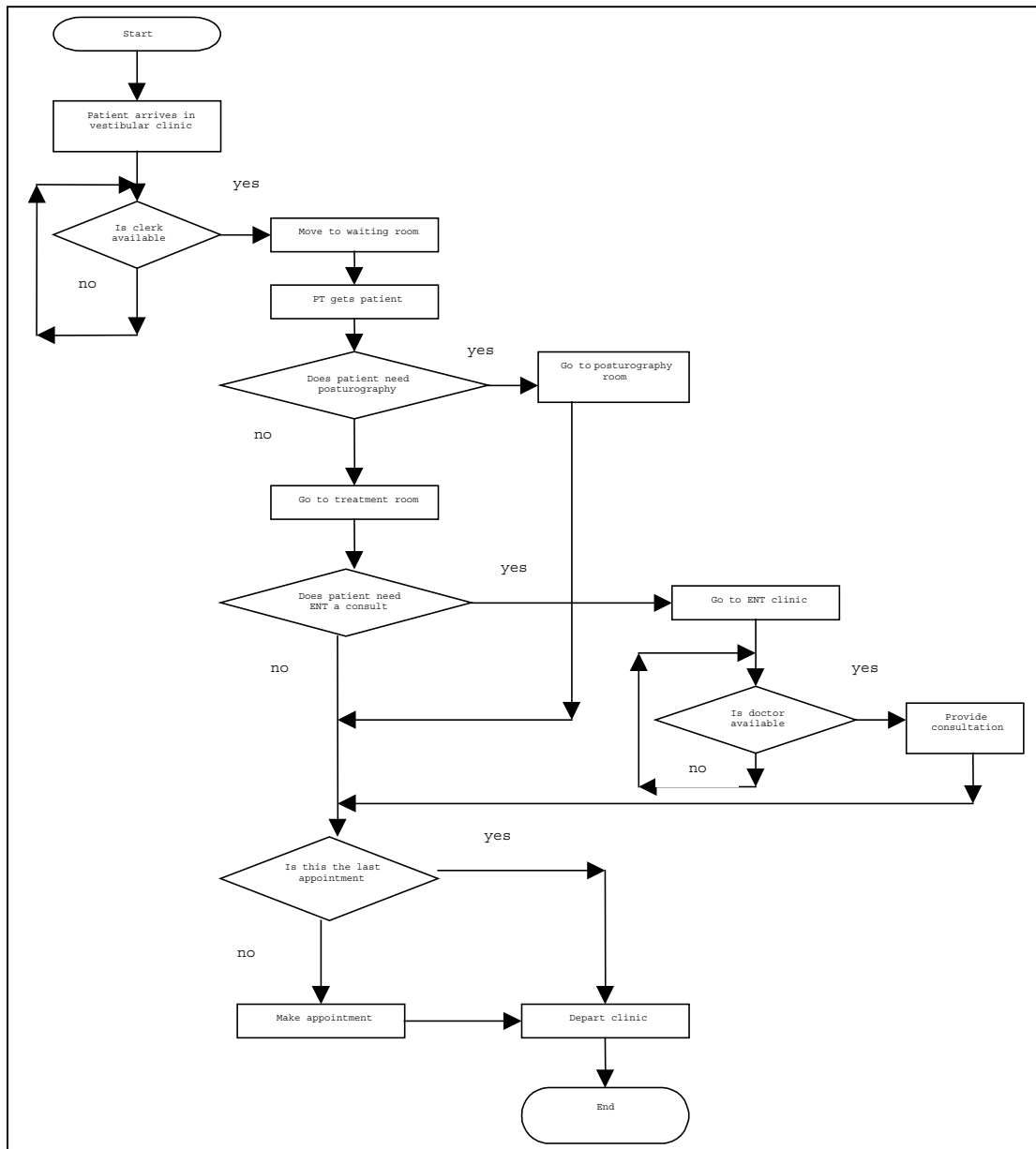


Figure 1: Patient Flow

Once the initial assessment is completed and a treatment regimen is selected, it takes one to two weeks to begin the determined cycle of vestibular rehabilitation treatment.

Patient time with the physical therapist accounts for the largest portion of the course of treatment. Accordingly, the largest portion of the physical therapist's schedule is dedicated to these appointments. In addition to the evaluation clinic the physical therapist's schedule template consists of hourly appointments four days per week. One of the afternoons is blocked off for administrative work. This template allows for a maximum of 21 scheduled treatment visits per week or 84 visits per month.

There is limited historical workload information available on vestibular rehabilitation patients seen at NMCSO. This is due in part to the physical therapist having just joined the clinic in May of 1998 and to the newness of the DSOC in general. As a result the monthly average of vestibular rehabilitation visits has grown from 17 in the summer of 1998 to 54 visits during the winter of the same year. These numbers are based on NMCSO Ambulatory Data System (ADS) data reported for the months of June, July and August and for November, December and January respectively. The current workload is intentionally below the projected maximum number of visits. In conversations with the neurotologist, he

shared that the referrals to the DSOC are currently limited to allow for a gradual expansion of the clinic.

Vestibular rehabilitation patients do not require treatment exclusively by the physical therapist. Once the specific treatment regimen is developed, a physical therapy technician can help the patient with the prescribed therapy; however, a technician is not currently available to provide this assistance.

As was stated earlier, the DSOC directors have identified spaces at MCAS to provide vestibular rehabilitation to active duty personnel. Ultimately, the plan is for DSOC to occupy a 5,000 square foot clinic on MCAS. Of that space, three rooms will be dedicated to vestibular rehabilitation treatment and additional rooms for specialized physical therapy equipment. Until the move to the new spaces occurs, the DSOC staff is sharing with the Medical Center physical therapy department two examination rooms in the existing MCAS base medical clinic.

The intermediate objective of the DSOC directors is to create a presence at MCAS. Comparing current workload to vestibular dysfunction incidence rates, there is a significant under-reporting of vestibular problems by military active duty (Hoffer, 1998, p. 2; National Institutes on Deafness, 1998). Although vestibular dysfunction can effect several occupational categories, flight related activities are

especially prone to this problem; the military air community is often reluctant to seek medical help. The fear is that many medical conditions can lead to time away from the squadron, or removal from flight status.

Making vestibular rehabilitation services available at MCAS is an important step in increasing access to care for active duty personnel. It will no longer take several hours out of the active duty member's day to see the physical therapist. Additionally, locating this clinic in Northern San Diego County will decrease the travel time for active duty personnel stationed at military bases further north of MCAS to get necessary vestibular rehabilitation. The move to MCAS will foster a relationship with the flight surgeon community, which is responsible for the overall health of squadron personnel. This step may ultimately lead to increased utilization of the vestibular rehabilitation services.

Historical workload data is currently unavailable for the MCAS medical clinic. Appointments at MCAS are currently dedicated to initial assessments of active duty personnel and the clinic is only held one afternoon per week. For the time being, most of the patients identified as needing a regimen of treatment continue to receive vestibular rehabilitation at NMCSO.

Currently, DSOC only has a single full time physical therapist assigned to the vestibular rehabilitation clinic.

The contract under which the physical therapist operates costs NMCSO approximately \$100,000 a year, including contract overhead costs. The salary for the administrative assistant, who covers functions in addition to the processing of the vestibular rehabilitation patients, is approximately \$26,000 per year. The physical therapist technician would be a Hospital Corpsmen First Class, with an annual salary of approximately \$32,000.

Study Objectives

The next step in phase one was to discuss the specific problems addressed through this research. There were three major areas: how the staffing mix impacts the clinic operation; how many patients the clinic must be able to treat; and how the clinic location impacts the clinic operation.

Staffing Issues

As was mentioned earlier, there are currently no physical therapy technicians available to assist the DSOC physical therapist. Conversations with the physical therapist make it clear that technicians could assist in the vestibular rehabilitation treatment process; this has the potential to significantly enhance the delivery of care to DSOC patients.

There are, however, limitations to the scope of care technicians can provide. They can neither evaluate new patients, nor assess treatment efficacy; they may, however, assist on established patients with documented treatment

plans. According to a NMCSO physical therapist, the medical center requires that the physical therapist perform specific supervision functions of the technician. She must evaluate the patient initially and again every thirty-days, documenting each encounter. She must also evaluate the patient at the end of the treatment cycle, documenting this event with a discharge note.

While the physical therapy technician will use the same appointment template as the physical therapist, it is expected that the technician will not require a full hour with each patient. The reason for the shorter treatment time relates to the limited scope of the physical therapy technician's role in patient care. Regardless, the total number of visits accomplished in the vestibular rehabilitation clinic will dramatically increase by allowing the physical therapy technician to see approximately half of the existing appointments. The question then becomes how much of an impact the physical therapy technician has on the patient workload? Moreover, will a second technician further increase clinic efficiency? These are questions that can be answered through the use of modeling.

Similarly, the simulation model needs to address the impact of augmenting the staffing mix with a second physical therapist. This addition should significantly increase the

number of patients seen as well as enable both clinic sites to operate simultaneously.

Workload Issues

In order to adequately assess the appropriate staffing mix through the use of modeling one must first determine the size of the projected patient population. Regional population information was used as a starting point in establishing a target workload projection.

Region Nine, Southern California, eligible TRICARE population is currently 637,000, according to the Corporate Executive Information System (CEIS) Beneficiary Population Profile Fiscal Year 1998 report. Using the annual incidence rate of vestibular dysfunction cited in the vestibular rehabilitation proposal of 1%, about 6,400 beneficiaries in this region will encounter vestibular difficulties at some time (Hoffer & Hunsaker, 1997, p. 7).

A review of the patients currently seen by the NMCSO neurotologists shows that there is a 20% referral rate to the DSOC vestibular clinic, meaning that there are potentially as many as 1,274 patients who could benefit from the treatment modalities developed by the vestibular clinic. Furthermore, based on a review of the initial evaluation clinic recommendations, 70% of the patients evaluated are advised to receive a treatment schedule of six appointments, per the DSOC

staff. Therefore, 5,351 appointments are needed to accommodate the demand.

Based on these numbers, 450 appointments are needed each month. This is about five times more visits than the 84 appointments currently available each month for vestibular rehabilitation.

Within the Region Nine total population figure, 22% or 143,000 people are on active duty, based on the CEIS Beneficiary Population Profile. Since this population has greater exposure to occupational hazards resulting in vestibular dysfunction their annual incidence rate of vestibular dysfunction is slightly higher than the population at large at 1.3% (Hoffer, 1998, p. 8). Using the same process as outlined above gives a more conservative number of patient visits for the vestibular rehabilitation program. However, it limits the clinic to treating active duty personnel only. The number of visits needed to support this component is 1,562 annually, or 130 monthly. While the number is smaller, a single physical therapist still cannot accommodate this number of visits.

Upon completion of this review of the population, the goal is to accommodate 5,500 visits, with a minimum requirement of expanding to 1,600 annual visits.

Location Impact

Another issue taken into consideration was the impact of clinic location on the treatment of active duty personnel. Placing the clinic on the MCAS reduces the time patients spend traveling to and from their appointments. This factor is extremely important in the eyes of the squadron commanders, and can perhaps influence whether or not DSOC will get the necessary support to move forward with the expanded vestibular rehabilitation clinic.

In summary, the objectives of this project are to determine the appropriate mix of physical therapists and technicians needed to provide care to the hundreds of people needing vestibular rehabilitation each month. Specifically, as the hypothesis states, this project will determine whether or not the projected staff mix satisfies the demand for appointments. The research project will also look at the impact of moving the care to the military base as it is recognized that this may play a major factor in whether or not the project is allowed to move forward.

Phase Two

In phase two of the research project, variables were defined in order to address the research objectives and the hypothesis. Additionally, this phase used the gathered background information on patient flow and staffing, to design the simulation model.

Definitions of Variables

Based on information gathered in phase one, model variables were identified. The operational definitions of the key variables are found in Figure 2.

Definitions of Variables
<p>The Patient Population consists of the total number of people needing vestibular rehabilitation appointments each year. This number is between 260 and 900 annually.</p>
<p>A Visit covers the period of time a patient spends in the facility, including waiting and treatment periods.</p>
<p>Visit Population is a function of the patient population and the number of visits each requires. Patients on average require six visits, therefore visit population is between 1,600 and 5,500.</p>
<p>The Staff Cost equates to the number of providers multiplied by their corresponding annual salary. The annual cost per physical therapist is \$100,000 and the annual cost per technician is \$32,000.</p>
<p>The Patient Cost includes the overhead expense of operating the vestibular clinic. For this research project this amount is seen as being the same for each of the clinic locations and is therefore not included in the total cost calculations.</p>
<p>Patient Treatment Time represents the length of time spent in treatment.</p>
<p>The Patient Processing Time is the total time the patient spends in the clinic.</p>
<p>Cost Savings represents the difference between the cost of seeing patients in the model and seeing them in the civilian community. TRICARE pays \$884 for the therapy while on average the therapy costs \$2,000 to \$2,500 (Hoffer & Hunsaker, 1997, p. 7).</p>

Figure 2: Definition of Variables

Model Design

A major portion of phase two is dedicated to constructing the simulation model. One of the keys in building a useful model is to have it grounded on the objectives, the data collected and the defined variables. The discussion in this section focuses on a few of the significant factors

influencing the development of the vestibular rehabilitation clinic model.

One of the first considerations was the appropriate amount of detail to include in the model design. It is important to balance the amount of detail built into the model with its potential for producing meaningful data. Bateman points out that, "unnecessary inclusion of extraneous detail results in high modeling costs...(and) slower response times to the problem at hand" (1997, p. 33).

For example, in this model the administrative assistant checks-in and makes appointments for the patients, but the majority of her day is dedicated to unrelated activities. Therefore, in order to simulate that she is not always available for the patient, a generic work entity was created to fill her time. It is not important to know how her entire day is spent, but simply what she does in direct support of the vestibular rehabilitation patients.

Another key element in the development of the model is to integrate the MCAS operations into those of the existing clinic. Since vestibular rehabilitation does not currently take place at MCAS, future MCAS operations are approximated based on the current NMCSO operations, and use the same processing logic. This is appropriate because treatment is not affected by the location. The major difference is that the

DSOC staff must currently carry the patient paperwork between the two locations.

Patients are either assigned to a new or follow-up appointment visit. Yet, when creating the patient distributions in the model, the more pertinent factor is the mix of rooms required to deliver the appropriate treatment to the patient. This is the case because the length of treatment time is about the same for new or established patients. The length of the appointment is thus, related to which treatment rooms are utilized during the appointment, Table 3.

Table 3: Patient Categories

Patient Type	Description
1	Treatment Room & Posturography
2	Treatment Room
3	Treatment Room & Neurotologist

The final major issue of the model design is the modification needed to handle changes in the mix of staff. This was accomplished at the end, once the base model operated correctly. Adding a physical therapy technician allows for shorter patient treatment times, the technician simply delivers treatment, and is not responsible for evaluation or extensive charting of the patient's progress. On the other hand, adding technicians requires that the physical therapist spend more time evaluating patient records outside of appointment slots. According to the physical therapist, this

increased supervision can be accomplished on either end of her shift, and it should not reduce the number of appointments in the physical therapist's schedule template.

Phase Three

Phase three of the project consisted of collecting data to determine the patient distributions, validating the model and finally running the model. The output obtained from running the model is found in the Results chapter.

Data Collection

The first step in this phase was to collect information on the frequency of patient types, the length of treatment and the inter-arrival times. A limited amount of historical data was available on the clinic workload. As this is a new function, institutional reports were most useful in generating a general understanding of the clinic operations. The major components missing from the available reports were patient treatment times and patient processing times. This latter time represents the total time the patient spends in the clinic.

Variability is inherent in any patient treatment process. The distribution of the patient treatment time was determined by evaluating a sample of patient visits. In order to capture this necessary information, a spreadsheet was developed which included the fields found in Table 4.

Table 4: Data Collection Categories

Category	Description
Date	Date of appointment
Appt Category	Follow up or New
Pt Type Code	Number corresponding to patient category
Room Used	Examination Rooms used by the patient
Primary Provider	Provider patient was scheduled to see
Additional Provider	Additional providers patients saw during visit
Appt Time	Time of patient's appointment
Arrival Time	Time the patient arrived at the clinic
Interarrival: Arrival	Difference between arrival and appointment times
Treatment Begins	Time appointment begins
Treatment Ends	Time appointment ends
Interarrival: Treatment	Difference between Treatment Begins and Treatment Ends times
Posturography Time	Length of Posturography
Departure Time	Time the patient left the clinic
Appt Time	Difference between Treatment Ends and Departure Times

The tool was used by the investigator and the staff physical therapist to collect approximately one month's worth of patient visit data. Data collection was not limited to the patients getting standard vestibular rehabilitation treatment; instead, data was collected on all patients seen by the physical therapist during this period. There were a total of 89 patient visits identified with 69 of those patients falling into the three defined patient categories. Table 5 displays the frequency of the patient category types. Using the standard error of the mean formula the sample size required for a 95% confidence level is 47 (Cooper & Emory, 1995, p. 215). This calculation used an error of estimate of four

minutes. Therefore, with these parameters, the data collected is sufficient for this research.

Table 5: Patient Distribution

Patient Number	Percentage
1	23
2	70
3	7

Tables 6 and 7, summarize the data collected on the patients seen in the vestibular rehabilitation clinic. These results were analyzed by Stat::Fit®, a statistics software package, to determine the corresponding patient distributions. These distributions were then added to the model's processing logic.

Table 6: Patient Treatment Time Data

Patient Category	Count	SD	Mean
1	16	9.53	52.00
1: Posturography	16	1.18	25.06
1: Examination	16	10.10	26.94
2	48	12.59	43.48
3	5	6.30	48.20
Total	89	14.39	41.42

Table 7: Patient Arrival Time Data

Patient Category	Count	SD	Mean
1	16	16.30	12.38
2	40	14.53	15.5
3	3	15.72	13.00
Total	73	13.98	14.73

Reliability and Validity

Once the data was collected and the model built, it was necessary to verify the validity and reliability of the instrument before attempting to produce useable output.

Reliability of a model tests whether or not the model produces consistent results (Cooper & Emory, 1995, p. 153). This is an important component of validity, but alone is not enough to prove the model's validity in providing meaningful research results. Subsequently, the results are tested to see if they accurately reflect the operation of the system under study (Bateman, Bowden, Gogg, Harrell, & Mott, 1997 p. 37).

For this research project the model's reliability was tested by running a single replication of the final model multiple times. The output of each replication was the same, demonstrating the reliability of the model.

Once the model's reliability was assured, its validity was tested. Bateman et al. recommends as a method of verifying validity of the model watching the animation as an effective method (1997, p. 37). When set at a slow rate, the observer can identify inconsistencies from the real life operation of the clinic. This method was used both by the researcher and by the DSOC staff, to test validity. Additionally, as the model was being built an experienced modeler reviewed the logic, helping to determine validity of the model (Bateman et al., 1997 p. 37). Finally, the model

should not simply be watched, but the output reports and the model variable counters should be compared to the expected results: for example, the census box must accurately reflect the number of patients actual visible in the clinic at a give point in time.

Based on these tests the model is both reliable and valid for representing the DSOC vestibular rehabilitation clinic, and therefore can be used to estimate the impact of changes on the staffing mix.

Running the Simulation

Computer simulation raises several specialized research issues. First, how many times should the model be run? Second, what length of time should constitute a single model replication? Finally, should the model run for a period of time before collecting results? This last question refers to the use of a warm-up period in the simulation, a period of time dedicated to bringing the model to what researchers call a steady-state.

One of the benefits of using computer simulation software, such as MedModel® is that it is easy to generate numerous sets of output data. However, it is still important to know how many data output points are needed to generate meaningful results. Using the same sample size formula mentioned earlier, the required number of replications of the model was determined. In this case 51 replications of the

model were required in order to give a 95% confidence level while maintaining the resulting patient treatment times output within 4 minutes of the actual measured times.

The length of each repetition is determined by natural cycles within the model being studied. For example if every Monday has the same number and type of appointments only one Monday needs to be included in the cycle. Furthermore, if every day of the week has the same number and type of appointments the repetition length needs only to include the single day. For the vestibular rehabilitation clinic, the cycle of appointments begins on Monday and ends on Thursday. Therefore, the length of a single repetition for this research project is equal to the four-day period of Monday through Thursday.

Simulation models generally fall into two categories, terminating or non-terminating. As the name suggests, non-terminating models do not have a defined starting and ending point. The classic example of a non-terminating model is of an emergency room. The emergency room never closes and therefore requires a warm-up period to adjust to the normal clinic operations. On the other hand, most outpatient clinics close at the end of the day, making them a terminating system. Since each day starts fresh, there is no need to have a warm-up period for the model. The vestibular rehabilitation clinic falls into the terminating model category.

RESULTS

In addition to the base, or existing model of the vestibular clinic, two additional models were created for data generation. The two modifications to the base model represent changes in staffing, and allow for the study of their impact on the clinic. The data captured by MedModel® for each of the three models are discussed in turn, and the results reported.

Before discussing the individual model results a few of the major findings are listed. The final scenario approaches the DSOC directors' goal of 5,500 annual patient visits. While there is considerable overtime seen in the model, the corresponding increase in staffing allows for the flexibility to decrease this shortcoming. Furthermore, it is predicted that the cost of providing vestibular rehabilitation to the patients is dramatically reduced by the addition of a physical therapy technician.

Base Model

The base model begins on Monday morning with the staff arriving at the clinic. Each morning the administrative assistant collects the medical chart and an ADS form for each scheduled patient appointment, placing the items on the physical therapist's desk.

NMCSD uses the ADS form to capture patient encounter data, and as the vestibular rehabilitation clinic does not

have the complete ADS computer system required to generate these forms within the clinic the administrative assistant retrieves the required documents from the otolaryngology department. If an unscheduled patient is seen during the day, the physical therapist must retrieve the ADS form before seeing the patient.

Next, patients arrive according to the established appointment schedule and the observed rates of walk-in appointments. As the patient enters the model the computer assigns the patient to one of the defined patient categories, shown earlier in Table 3.

After the patient arrives in the Medical Center they proceed to the reception area. A layout of the vestibular rehabilitation clinic and its location in relationship to the otolaryngology department is shown in Figure 3. This figure, the background for the model, displays a series of rooms representing the clinic space DSOC utilizes at MCAS. This background also offers a visual of the various locations utilized throughout the patient's course of treatment.

Upon entering the vestibular rehabilitation clinic, the patient waits for either the physical therapist or the administrative assistant to acknowledge his arrival. Following this interaction, the patient takes a seat in the waiting area until the physical therapist is ready to begin the appointment.

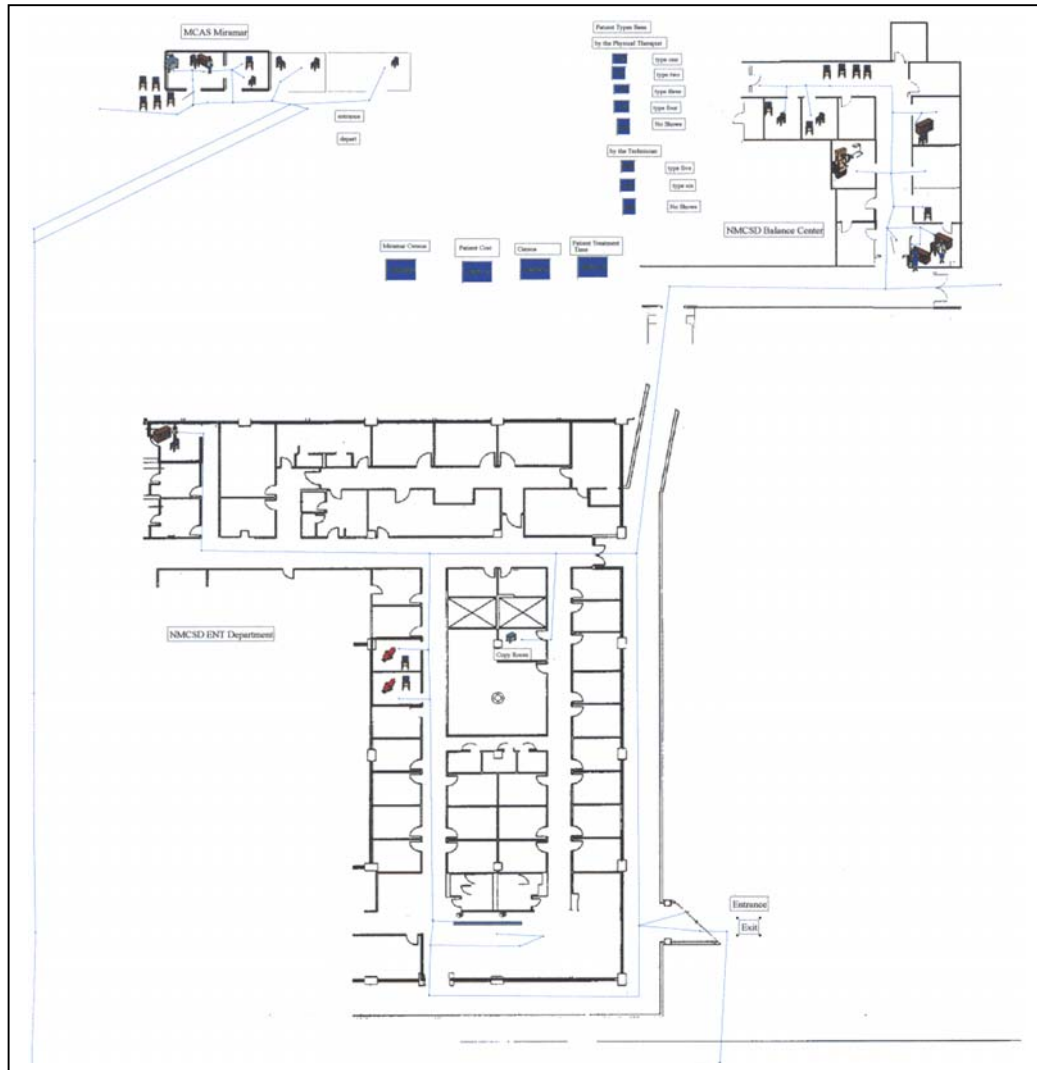


Figure 3: Model Background

Once the physical therapist is available she collects the patient's medical chart and corresponding ADS form, and then escorts the patient to the appropriate treatment room.

Depending on the patient category assignment, the patient and physical therapist may subsequently move to a second treatment room. This includes possibly moving to the otolaryngology

department, which then requires the physical therapist and the patient to wait for the neurotologist to become available for consultation. At the completion of this consultation the neurotologist and the physical therapist are free to attend to their next patient, and the current patient returns to the vestibular rehabilitation clinic reception area. Patients who are seen solely in the vestibular rehabilitation clinic also end their treatment session by returning to the reception area. If the administrative assistant is available, the patient schedules his next appointment. When the administrative assistant is not available the patient is told to call back at a later time. In this second case, the model shows the patient waiting for about two minutes and then exiting the Medical Center. This time is consistent with observations made in the clinic.

For each patient visit the physical therapist must complete an entry into the patient's medical chart and fill out the matching ADS form. The physical therapist tries to do as much of this as possible during the scheduled appointment time, while the patient is executing the treatment modalities. This allows for more accurate reporting of the appointment's events and better utilization of the physical therapist's time. In the model, the ADS completion is seen to occur at the beginning of the patient visit and the documentation within the chart occurs at the end of the patient visit. Also

within the time assigned for the chart completion is time allowed for the travel of the physical therapist to the otolaryngology department. Since the vestibular rehabilitation clinic maintains a chart for each patient separate from the patient's official medical record, the physical therapist copies the chart entry at the end of each visit. This is done in the otolaryngology department and the copy is sent to the Medical Center's medical records department to chronicle the patient's visit. Likewise, each completed patient ADS form must be taken to the otolaryngology department where the patient encounter data is tabulated for the vestibular rehabilitation clinic.

Patients arrive throughout the day according to the defined schedule: three appointments both in the morning and in the afternoon. Arrival rates and treatment times are based on the distributions observed during the data collection period. The model processing logic prevents 5% of the scheduled patients from arriving at the entrance of the clinic. This represents the patients who fail to show up for their scheduled appointments. Similarly, the model is designed to send in an unscheduled patient to the clinic each day. This occurs, for practical reasons, during the morning. This addition to the model's processing logic represents the three to five patients per week who walk-in into the clinic

looking for an immediate appointment. Currently, every effort is made to see these patients at least for a few minutes.

In addition to the inherent work produced by the patients, the model generates telephone calls for the physical therapist and generic work items for the administrative assistant. Both the phone calls and the administrative work assignments are based on observed rates of occurrence and on conversations with the DSOC staff. The generic work simulates the time the assistant is not available to check-in patients or to make their follow-up appointments. This is time she spends working on documents, making copies, and taking phone calls for the various DSOC staff. On the other hand, the model does not include the other responsibilities of the physical therapist such as attending to other clinical duties, administrative requirements or research initiatives. Also included in the model are defined employee shifts, including starting and ending periods as well as assigned lunch breaks. These shifts are based on the actual assigned work schedules for the physical therapist and the administrative assistant. Within the model logic, the physical therapist is told to skip her lunch break if there are still patients in the clinic, and she is not allowed to go home at the end of the day until all of the patients have departed the clinic.

As was stated earlier, this model is designed to capture only the events surrounding the patients identified as needing

vestibular rehabilitation. Therefore, the length of the model is limited to the first four days of the week. This is representative of the amount of time each week the physical therapist currently spends dedicated to rehabilitation work. The daily cycle, as outlined in this section thus far, repeats Tuesday and Wednesday as well as Thursday mornings. There is however one slight modification found with Wednesday afternoon. The same number of patient visits occur, except they take place at the MCAS clinic. Patient category assignment is made in the same manner as at NMCSO, however the number of categories is reduced to two. Patients either receive treatment alone or they receive treatment and a posturography examination. The posturography examination consists of the patient standing on a platform that moves in various directions. The machine measures the patient's ability to compensate for the platform's movement, thus assisting the physical therapist in diagnosing the patient's degree of vestibular dysfunction. At least for the near future the neurotologist is not routinely available for patient consultation when the appointment is at the MCAS clinic and therefore this type of patient visit does not currently occur at MCAS.

The physical therapist must again complete a medical record entry and an ADS form on each patient. This paperwork is handled in the same way as at NMCSO, and as previously

outlined, the records are returned to the otolaryngology department of NMCSD. The simulation is set to end early Thursday afternoon, as the afternoon represents the physical therapist's administrative time.

The processing logic of the models is designed to capture several pieces of data, Table 8. First, the model tells how many patients are seen by the physical therapist during the course of a week. In the base model, the weekly mean of patients seen was 23.94. This number includes both scheduled and walk-in appointments and also accounts for the 5% no-show rate.

Table 8: Base Model Results

Category		Result
Patients Seen Per Week	Mean/SD	23.94/0.88
Patient Processing Time in minutes	Mean/SD	83.21/4.49
Treatment Cost per visit	Mean/SD	153.05/4.23
Patient Wait Time in minutes	Mean/SD	17.96/3.08
Physical Therapist Utilization Rate		76.17
Hours of Overtime Worked		5.23

Next MedModel® processing logic was designed to report both the patient processing time and how long the patient spends waiting for staff members during their visit to the clinic. Patient processing time includes such items as waiting for the administrative assistant to make another visit appointment as well as time spent with the physical therapist on rehabilitation activities. Patient processing time ranged

between 42 and 161 minutes. Of the 83.21 minutes mean processing time, the patient spent 17.96 minutes waiting for the physical therapist, the administrative assistant or the neurotologist.

Another item collected through the model design is the cost of each patient visit. This information is based on the amount of time the patient spends with each of the defined staff members, physical therapist, administrative assistant and the neurotologist, and their corresponding salary. The salary for each staff member is determined and then broken down into an hourly rate. The reported \$153 patient visit cost represents only the salary costs expended in support of the patient visit. It does not include any overhead costs of operating the clinic, as NMCSD does not capture this information. While the figure is not comprehensive, the resulting data allows for the comparison of the proposed staffing mixes of the subsequent scenarios.

Finally, the base model, as well as the subsequent scenarios, is designed to capture the utilization rates and overtime worked by each of the staff members. MedModel® defines utilization as the portion of the shift occupied by both the time it takes to get to the location of the next assigned duty as well as the time spent performing those tasks (MedModel®, 1997 p. 532). The length of the shift is also adjusted to account for times the staff member did not take a

scheduled lunch break or was required to work overtime. With this first model, the physical therapist has a utilization rate of 76%. Utilization rates for the administrative assistant are not included, as she has limited impact on the overall patient visit.

Scenario One

The first scenario looks at the impact of adding another provider to the vestibular rehabilitation clinic staff. Scenario one starts with the basic model design but adds a physical therapy technician to the staffing mix. This requires doubling the appointment template, allowing each provider to see six patients per day.

In addition to changing the template, there are a few other minor processing logic modifications necessary to accommodate the addition of the physical therapy technician. For example, the technician is allowed to collect the ADS form from the otolaryngology department and to make follow-up appointments for the patients. The processing logic is designed to require the physical therapist to review the medical records of each patient seen by the technician.

While the patient categories for the physical therapist do not change under this scenario, the addition of the technician requires two new categories. First, the technician can see routine patients simply needing treatment. A second category of patient the technician can see is patients

requiring the technician to consult with the physical therapist. This is estimated to occur in approximately 10% of the patients. The consultation requires the physical therapist to leave her present task and join the technician in the treatment room with the patient needing additional evaluation.

Although the technician does not spend quite as much time with the assigned patients as the physical therapist does, the appointment template was not modified. Leaving the appointment length constant provides a small buffer for the treatment time, and may result in a slight underestimation of the impact that adding the technician to the provider mix has on the total number of patients visits. This seemed a reasonable approach since a technician is not currently used and it is not known for certain how long it will take the technician to perform the necessary treatment modalities with the assigned patients.

Table 9 displays the output generated by MedModel® for this first change to the staffing mix. The same data items were collected for this scenario, as with the base model. However, the table is expanded to collect individualized utilization and overtime data for the physical therapist and the technician.

Consistent with doubling the appointment template, the model resulted in a weekly mean of 45.57 patient visits. This occurred with less than a 4%, or three minute, increase to the

patient processing time. The changes to the model did however, expand the maximum processing time by 34 minutes. Since the physical therapist has more responsibilities with this model, her utilization rate increased. However, since there is now another person available to collect some of the patient documentation and to check-in patients, the patient wait times decreased by nearly 11 minutes or 59%.

Table 9: Scenario One Results

Category		Result
Patients Seen Per Week	Mean/SD	45.57/1.72
Patient Processing Time in minutes	Mean/SD	86.38/5.44
Treatment Cost per visit	Mean/SD	85.87/3.71
Patient Wait Time in minutes	Mean/SD	7.43/1.99
Physical Therapist Utilization Rate		86.36
Technician Utilization Rate		50.73
Hours of Overtime Worked: Physical Therapist		6.29
Hours of Overtime Worked: Technician		6.14

Scenario Two

Taking scenario one further, scenario two demonstrates what happens when a second physical therapist and a second technician are added to the clinic staff. The most significant adjustment to the model design occurs in this scenario. The addition of a second physical therapist and a second technician means that now there is sufficient staff to allow the NMCS and MCAS clinics to function simultaneously. Again the patient template is expanded to allow each provider to see six patients per day. Walk-in and no-show patient

rates remain constant with the MCAS physical therapist continuing to see only treatment and treatment and posturography patients. The only logic modifications in this scenario relate to tracking the number of patients seen at MCAS or at NMCSO.

Table 10: Scenario Two Results

Category		Result
Patients Seen Per Week	Mean/SD	91.22/1.95
Patient Processing Time in minutes	Mean/SD	81.45/3.37
Treatment Cost per visit	Mean/SD	84.36/1.63
Patient Wait Time in minutes	Mean/SD	7.51/1.48
Balboa		
Physical Therapist Utilization Rate		85.75
Technician Utilization Rate		50.36
Miramar		
Physical Therapist Utilization Rate		85.11
Technician Utilization Rate		49.14
Balboa		
Hours of Overtime Worked: Physical Therapist		7.07
Hours of Overtime Worked: Technician		6.82
Miramar		
Hours of Overtime Worked: Physical Therapist		5.91
Hours of Overtime Worked: Physical Therapist		5.66

Once more the model was set to run for the first four days of the week and to collect information on the number of patients seen, the staff utilization and the patient processing times. The complete set of results is found in Table 10.

This final model predicts that with four full-time providers the clinic can see approximately 4,600 appointments annually, nearly doubling again the number of patient visits

from scenario one. With this model the provider utilization rates and overtime hours are still higher than reported in the base model. However, the rates are reduced slightly from the scenario with only one physical therapist and one technician. Notably, the maximum patient processing time continues to grow as providers are added to the clinic staff. This model predicts a maximum patient processing time of 205 minutes or nearly 3.5 hours. It is important to remember that this is only the maximum processing time and that it does not occur routinely. Indeed, this value can be associated with a walk-in patient waiting for a same day appointment. Processing time variation is also seen on the lower limit with this model, reducing the minimum wait by six minutes under the base and first scenario models.

DISCUSSION

The research results show that with additional staff the clinic can successfully begin to treat significantly more of Region Nine's beneficiaries who experience vestibular dysfunction. Staffing a second clinic with a technician and a physical therapist increases patient visits by 281% to approximately 4,600 annual appointments. More importantly, the larger staff allows for increased flexibility in the delivery of health care for vestibular rehabilitation patients, as well as opening a clinic at MCAS, which increases accessibility for active duty personnel. This increase in service is accomplished with decreased patient waiting times as well as decreased patient visit costs. Furthermore, the proposed changes demonstrate improvements across most categories of collected data.

The cost of providing vestibular rehabilitation treatment impacts the future of the clinic. Therefore, it is the first discussion topic.

One of the assumptions for creating the computer models was that the same physical therapy equipment would be needed at both NMCSO and MCAS. Similarly, with the exception of not being able to routinely consult with the neurotologist at the MCAS clinic, essentially the same procedures were performed at both the MCAS and the NMCSO clinics. Therefore, the overhead

costs for seeing patients at either site, for analysis purposes, was the same. This allows for the comparison of a single employee to multiple employees. Another reason for not including the overhead costs was because NMCSO does not currently collect data on the vestibular rehabilitation clinic costs.

The results of the research project predict that it is more cost effective to spread the patient visits between technician and physical therapist than having the physical therapist work alone in the clinic. Assuring, of course, the technician is only assigned patients commensurate with his skills. Scenarios one and two decrease the cost of providing care 44% and 45% respectively, while increasing the total number of patients seen.

These treatment costs also need to be compared with the TRICARE approved reimbursement rates. TRICARE, the government's managed health care program, reimburses qualified civilian providers for providing health care to eligible beneficiaries. In this case the maximum reimbursement for a series of vestibular rehabilitation treatments is \$884. Assuming that the civilian physical therapists provide approximately six visits as a series of treatment, as performed in the DSOC, the TRICARE reimbursement equates to roughly \$150 per visit. While the collected data from the research models only account for the salary portion of the

clinic, the \$84 per visit cost of the final scenario allows for up to \$66 worth of overhead to be assigned to each patient. Much of the physical therapy equipment is already in place and does not require frequent updating; as a result the overhead figure should be a relatively low amount. It is therefore not only more cost effective for the clinic to add additional staff to their mix of providers, but it also seems reasonable to expect the government to realize a cost savings by expanding this clinic's capabilities.

One of the interesting anomalies of the research deals with comparing the patient processing times to the patient waiting times. The addition of more staff did not effect the patient processing times. Adding a technician increased the processing time by only three minutes, while opening the second clinic full-time reduced the processing time by two minutes from the base model. Overall, the time the patient spent in the system is roughly the same for all three of the models.

Looking simultaneously at the length of time the patient spends waiting for one of the employees at the various stages of his visit shows a significant decrease from the base model. In scenarios one and two the patient only spends about seven minutes waiting for the various clinic staff, compared to 17 minutes in the base model. Clearly, this represents an

improvement in the method of delivering health care to these patients.

The anomaly appears when one pictures the patient spending the same amount of processing time in the various models, but also waiting less time for staff members to become available. These results suggest that the treatment time for the patients increased. However, the only change in treatment times relates to the physical therapy technician. Yet, the technician spends, on average, less time with each patient than the physical therapist spends treating the patients.

This phenomenon needs further review. One possible explanation is that the distribution of the technician's treatment times requires adjustment and thus may represent a limitation of this research. Currently, the technician treatment times are fairly constant. In comparison, the physical therapy treatment times vary between five minutes for an uncomplicated walk-in appointment and 70 minutes for a fairly difficult patient. Ideally, a technician in an existing vestibular rehabilitation clinic would have been observed and his treatment times then used to build the models. Even without this more precise data, the models presented through this research show that the amount of time the patient spends waiting for clinic staff is low and processing times are held fairly constant.

Next, staff utilization rates are studied. This is done because the rates are an important tool for determining the appropriate mix of staff as well as the likelihood of meeting the mission of seeing 5,500 appointments annually. As was stated before, adding a technician comes with limitations. With this change, the physical therapist must now review the medical records of both her own patients as well as of those patients seen by the technician. It makes sense that the model would predict that the physical therapist's utilization rate increases with the addition of a technician. In this research project the physical therapist's utilization rate increased from 76% to 86%.

At first glance it appears that a single technician, with a utilization rate of about 50%, could assist two physical therapists, this is an incorrect assumption. Instead the decision-maker needs to be concerned that the physical therapist utilization rates are too high.

There are two main reasons for this assertion. First, it is unrealistic to have the physical therapists regularly work five to six hours of over-time per week, as is occurring in the various models. Second, by having such a high utilization rate when only patient care is being modeled, leaves no time in the physical therapist's schedule to complete other required responsibilities, such as administrative and other clinical duties. MedModel® support staff suggest that the

ideal utilization rate is about 70%, thus allowing for the other portions of the job not included in the model.

Therefore, while the technician may be slightly underutilized, his responsibilities can not be significantly increased.

Furthermore, the physical therapist's duties must be slightly modified to bring her utilization rate down to an acceptable level.

Not only are the utilization rates too high for physical therapists, the physical therapists and technicians are routinely working overtime to see the scheduled and walk-in patients. The overtime was not seen solely in the scenario modifications, but also in the computerized version of the existing clinic operations. This was not foreseen as a possible problem with the existing clinic operations because the current appointment template is only now starting to be completely filled by patients. At the time of the models' construction, there frequently were appointments immediately available for patients seeking care. When the patient template is full, which is starting to occur more regularly, the physical therapist does indeed work overtime.

Finally, it is not until a second physical therapist and a second technician are added, scenario two, that the clinic approaches the DSOC directors' goal of 5,500 annual patient visits. With the current staff of only a physical therapist the most the clinic can hope to see is 1,200 visits annually

and adding a technician only increases this number by 1,100 visits. Adding the three new staff members outlined in scenario two, not only allows the vestibular rehabilitation clinic to see more of the requisite number of visits, the DSOC directors then have the flexibility to see patients at either the Medical Center or at MCAS. This is a very important addition as it allows for increased access to treatment by active duty personnel. While scenario two continues to show significant amounts of overtime worked by the staff, with a second full-time physical therapist the DSOC directors have the option of adjusting that person's hours to spread the existing appointment template over a five day period, thus reducing the utilization and overtime rates. Therefore scenario two accomplishes the goal of accommodating 5,500 annual patient visits.

CONCLUSIONS AND RECOMMENDATIONS

Overall, this research project used computer simulation to study the impact of staffing changes without effecting patient care. Such a methodology is extremely important in not only supporting data drive decisions, but also in allowing for more timely results. No longer are leaders forced to make a change in staff and then wait a year to see the impact of the modification, often at significant cost.

Specifically from this research project, the DSOC directors are encouraged to move forward with adding a physical therapy technician immediately and then after that a second physical therapist and a technician. These actions will allow for the DSOC vestibular rehabilitation clinic to see nearly 5,500 patient visits annually, and perhaps more importantly open a second clinic full-time on MCAS. This second part is paramount in seeking the support of military line commanders for expanding the clinic.

Regardless of the decision on adding staff to the clinic, the DSOC staff should adjust the current patient template. This action is necessary to ensure that when all of the appointments are filled, the physical therapist is not forced to routinely work overtime. MedModel® can assist in this process. Future research could include development of several possible appointment templates and then insert them as

scenarios in the final MedModel® model prepared for this research. Then the computer application could be set to optimize, based on the resulting staff utilization rates. Ideally, this further analysis will not occur until two events take place. First, at a minimum, one technician should be added to the staff. This will allow the researcher to update the model with more accurate treatment times and practice patterns. Second, the clinic should operate for several months at a higher level of workload. By allowing this to occur, the clinic operations will solidify, giving a better indication of the impact of changing the patient templates.

This research project does not immediately address the need for additional administrative staff. Antidotally, it appears the administrative assistant will not be able to maintain the templates for the current and the potentially three new providers in addition to her many other responsibilities. The technicians perhaps could handle some of the additional workload, but the DSOC directors are best served to further study this situation.

Another minor item that would improve clinic efficiency is to move an ADS device into the vestibular rehabilitation clinic. Similarly, the administrative assistant should have the capability to record the ADS forms generated each day. Making these changes will reduce the amount of time spent walking between the vestibular rehabilitation clinic and the

otolaryngology department. This same equipment and capability must also be included in the MCAS clinic spaces.

Finally, the government should continue to fully utilize the in-house vestibular rehabilitation services. This action allows the government to avoid the \$884, per treatment series, TRICARE reimbursement. It is important to note vestibular rehabilitation is a relatively new field, and as it expands, the civilian medical community most likely will increase their charges for this service. Therefore, it is important to have the in-house mechanism the DSOC offers the military health care beneficiaries. This will result in better utilization of government dollars and allow for the more timely treatment of active duty personnel. This is especially true because the second clinic is located on MCAS. Towards this end, all referrals to the civilian community for vestibular rehabilitation should first be review and approved by the NMCSN neurologists.

In summary, the research project hypothesis must be accepted. That is to say, the current mix of clinic staff can not successfully accommodate the mission of the DSOC. To move forward with treating the operational forces additional staff is required. This research project presents a means by which the mission can be accomplished and gives the DSOC leaders the necessary data to support the complicated efforts of getting authorization to hire additional staff. MedModel® has proven

to be a valuable tool in accomplishing this research project and the models created can now be easily modified to address other concerns of the DSOC directors.

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